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ROLE OF POLLEX FOR HAND FUNCTION

(Professional paper)

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Abstract

Frequent traumatism and accidents are prerequisite to direct our attention to the functional recovery of the upper limb and primarily role of thumb for gripping power of the hand. The aim of this study is to make kinesiological analysis of the pollex and its role in the function of the hand. The hand is able to perform all the complex and multilateral activities, thanks to the rare qualities that possess: high sensitivity, rich motor capabilities with significant clamping force and enviable coordination and finesse, realize on the basis of perfect cyber regulation. The role of the pollex of the hand is determined by the fact that only there have independent articulatio carpo-metacarpea, which made complex movement (begins with abduction, passing in adduction and slight flexion in metakarpophalangeal and interphalangeal joints, ends with rotation and opposition). This allows him to perform opposing the other fingers (opposition) and making hookup – function of the human hand is brought to perfection. Fullest possible recovery of the hand requires firstly – restoring individual function parameters and secondly – restoration of the whole person of the patient, its psyche, capacity for work, its social and economic status.

Keywords: *capacity for work, kinesiological analysis of the pollex, kinetic analysis of hand, sports activities, coordination of fingers*

INTRODUCTION

All equipments and technical devices created by mankind are designed and realized by the human mind, and shall be implemented by the hands of the individual.

When we are healthy, never thinking about the role of the upper limbs in normal life. But when there is a problem, we realize how much our lives has been changed (Yates,1999).

Accidents are frequent prerequisite to direct our attention to the functional recovery of the upper limb and foremost role of thumb for gripping power of the hand (Bosnev & Matev, 1989); Popov, 1987).

The aim of this study is to make kinesiological analysis of the pollex and its role in the function of the hand.

METHODS

The hand is able to perform all the complex and multilateral activities, thanks to the rare qualities that possess: high sensitivity, rich motor capabilities with significant clamping force and enviable coordination and finesse, realize on the basis of perfect cyber regulation (Матев (Matev) & Банков (Bankov), 1977).

Skeleton hand – *manus* – consists of three located one after the other groups of bones: ossa carpi, ossa metacarpalia and phalanges.

The bones of the fingers (phalanges) are primary, secondary and nail. The pollex has only basic and nail phalanx.

The bones of the hand (manus) are combined together into two groups of joints: joints of the wrist and joints of the fingers. In art. Carpometacarpea of fingers II-V movements are insignificant and have springy characteristic, while art. carpometacarpea pollicis is completely independent. In it is combined trapezoidal bone at the base of the first metacarpalia bone. Articular surfaces are saddle-shaped, which allows two degrees freedom of movement on two main axes: on the front-rear axis is carried abduction and adduction 45-60° and a transverse axis - flexion and opponents of pollex to the other fingers and extension - reset total 35-40°. The looseness of this joint allows rotation around the longitudinal axis, which favors the opposition of the thumb and increases immensely gripping capabilities of the hand. *Articulatio metacarpophalangeal pollicis is cumulus and has three degrees freedom of movement:* movements in the sagittal plane from 30° до 90° flexion and 5-10° extension. Details of movements in the frontal plane is occur rarely in the literature – about 30° abduction and 10° adduction (Матев (Matev), 1978).

In *Articulationes interphalangeae* takes placearticu-

lation between the phalanges of the fingers like pollex have only one joint and it can be done flexion of about 90°.

Bones, joints and skeletal muscles build the motor apparatus of the human (Morov, 1981). Bones and joints compose passive part of motor apparatus, while muscles compose its active part, because the movements are the result of their cuts.

Antebrachial muscles acting on the pollex: *m. flexor pollicis longus* flexes the pollex in all his joints and participate in manus adduction (n. medianus); *m. abductor pollicis longus* makes abduction os metacarpi pollicis and of hand in wrist (n. radialis); *m. extensor pollicis brevis* in wrist and metacarpi joint pollicis support abduction, and essentially extends the main phalanx of pollex (n. radialis); *m. extensor pollicis longus* extends the pollex in all his joints and of hand in wrist (n. radialis).

The muscles of pollex are small, short, four in number, forming the cushion of the pollex – *thenar: m. abductor pollicis brevis abduct* ossa metacarpalia of the pollex and extends the pollex in the main phalanx (n. medianus); *m. flexor* ***pollicis brevis*** flexes the pollex and supporting its opposition to the other fingers (n. medianus); *m. opponens pollicis* oppose the pollex to the other fingers (n. medianus); *m. adductor pollicis* flexes the main phalanx and adduct the pollex thus supports the opposition of the pollex to the other fingers (n. ulnaris).

DISCUSSION

Great mobility, autonomy and diversity of the movements of the thumb due to the fact that these small muscles always act synchronously with its larger muscles located in the forearm (Kojuharov, 1988).

The muscles of the hand made fine, small, coordinating movements, which they complement the activity of the muscles and give predmishnichnite hand dexterity, accuracy and precision grip, so necessary for employment rights (Kalchev & Morova, 1993).

Wrist forms flexible connection between the forearm and hand, and it have a kinesiologic role which is to optimally positioned to perform fine motor actions.

Many movement coordinations in the operation of various motor elements is carried out by the coordination of muscle activity – involving several muscle and each performs different tasks: as *agonists, antagonists, stabilizers and neutralizers.*

Significant mobility in each of the individual elements (rays) is due to a large number of contained therein kinetic couples (joints), and large number of muscles with diverse and highly differentiated action securing fine and precise movements of each element of the kinetic chain.

The role of the pollex of the hand is determined by the fact that only there have independent articulatio carpo-metacarpea, which makes complex movements (begins with abduction, passing in adduction and slight flexion in metakarpophalangeal and interphalangeal joints, ends with rotation and opposition). This allows him to perform opposing the other fingers (opposition) and making hookup– function of the human hand is brought to perfection (Kapandji, 1970).

Figure 1. presents fingers shaped like a butterfly with a rigid body and flexible wings. Position of „wings" helps the opposition of pollex to the little finger. Radial „wing" is more mobile and shorter than the ulnar due to the mobility of the first carpo-metacarpal joint of pollex (Popov, 2003).

If damage or loss of pollex (amputation), the hand loses over 70% of working capacity, especially if the affected dominant upper limb.

Along with goniometry applied to measure the larger joints are used and some tests to determine the mobility of the fingers. These are the different types of prehensile movements (grip - the hand ability to cover and hold different objects) (Matev & Bankov, 1977).

The movements of the hand (wrist and fingers) are two main groups (Fig. 2.):

* *Non prehensile movements* – the object is influenced by pushing, clapping, lifting movements of the hand or fingers separated;

* *Prehensile movements (grips)* **–** the object wholly or partly can cover and hold with the palm and fingers, in which participate all joints of the hand simultaneously.

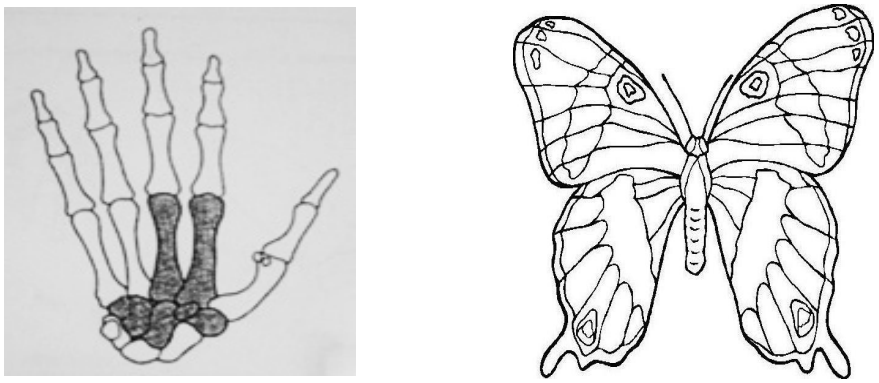

Figure 1. Scheme of mobile and fixed structure of hand

In view of the position of the hand and its function the grips are power (spherical, cylindrical, fist, as hook) and precision (peak, palmar, scissor, as key).

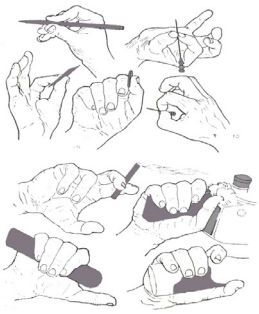

Figure 2. Types of grips (precision and power)

In the power grip the object is squeezed between part of the fingers flexion and palm, as the thumb and thenar are the mainstay of the hand which opposing the pressure of fingers and contributes to grip strength. In precision grip – pulps of the pollex and forefinger withstand and perform sophisticated actions of the hand.

When necessary grip with maximum force, *functional position of the wrist* is the extension (20-35°) and light ulnar deviation (10-15°). When necessary grip with maximum force, functional position of the wrist is extension and light ulnar deviation. This position allows full flexion of the fingers as the wrist extensors stabilize grip (9).

In flexion of the wrist grip strength decreased significantly. The reasons for this are that the flexors of the fingers go into active disease and extensors in a passive failure (Fig.3.).

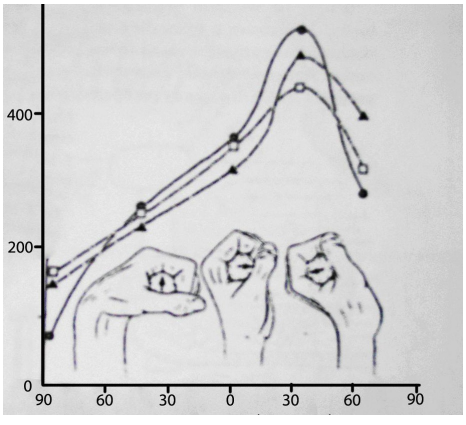

Figure 3. Position of the wrist determining grip strength

For work in daily life the hands are characterized by constant, but varied physical activity. Performing more movements and less maintaining certain static positions.

Many coordination in the operation of various engine components gives great practical possibilities for complex and precise movements combined, both volume and degree of freedom of movement, and coordination of muscular activity.

In traumatic injury of the hand firstly losing one's ability to be self-sufficient, becomes dependent on foreign aid and lost for a time their ability to work. This requires implementation of comprehensive physiotherapy and rehabilitation treatment to restore the function of the upper limb.

Fullest possible recovery of the hand requires firstly – restoring individual function parameters and secondly – restoration of the whole person of the patient, his psyche, capacity for work, his social and economic status.

CONCLUSIONS

Kinetic analysis of hand movements and technological analysis of the different work activities are reliable tool for selecting the most appropriate work activities and daily living activities, contributing to a better functional recovery of traumatized limb.

Good functional status of the entire upper limb is essential for carrying out sports activities. For most types of sport requires grip of equipment with sufficient strength and durability, and for other sports requiring precision - an excellent dexterity and coordination of the hand and fingers. Impaired function of the hand can prevent the best sports achievements in almost all sports, with a few exceptions - football, swimming and more. This requires a professional, responsible and timely conduct of athletes and therapists to all diseases and injuries of the hand.

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